INTERNATIONAL BACCALAURÉAT BACHILLERATO

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BACCALAUREATE INTERNATIONAL INTERNACIONAL

MARKSCHEME

November 2003

ENVIRONMENTAL SYSTEMS

Standard Level

Paper 3

14 pages

1. Follow the markscheme provided, do **not** use decimals or fractions and mark in **RED**.

2. Where a mark is awarded, a tick (✓) should be placed in the text at the **precise point** where it becomes clear that the candidate deserves the mark.

3. Sometimes, careful consideration is required to decide whether or not to award a mark. In these cases write a brief annotation in the **left hand margin** to explain your decision. You are encouraged to write comments where it helps clarity, especially for moderation and re-marking.

4. Unexplained symbols or personal codes/notations on their own are unacceptable.

5. Record subtotals (where applicable) in the right-hand margin against the part of the answer to which they refer next to the mark allocation. Do **not** circle subtotals. **Circle the total mark for the question in the right-hand margin opposite the last line of the answer.**

6. Where an answer to a part question is worth no marks, put a zero in the right-hand margin.

7. For each Option: Add the totals for each question in the Option and write it in the Examiner column on the cover sheet.
   Total: Add the marks awarded and enter this in the box marked TOTAL in the Examiner column on the cover sheet.

8. After entering the marks on the cover sheet, check your addition to ensure that you have not made an error. Check also that you have transferred the marks correctly to the cover sheet. **We have script checking and a note of all clerical errors may be given in feedback to examiners.**

9. Every page and every question must have an indication that you have marked it. Do this by **writing your initials** on each page where you have made no other mark.

10. If a candidate has attempted more than the prescribed number of Options within the paper, mark only the required number of Options in the order in which they are presented in the paper, **unless the candidate has indicated the Options s/he wants to be marked on the cover sheet**.

11. A candidate can be penalised if he/she clearly contradicts him/herself within an answer. Make a comment to this effect in the left hand margin.

Subject Details: **Environmental Systems SL Paper 3 Markscheme**

General

A markscheme often has more specific points worthy of a mark than the total allows. This is intentional. Do not award more than the maximum marks allowed for part of a question.

When deciding upon alternative answers by candidates to those given in the markscheme, consider the following points:

◆ Each marking point has a separate line and the end is signified by means of a semicolon (;).

◆ An alternative answer or wording is indicated in the markscheme by a "/"; either wording can be accepted.

◆ Words in (…) in the markscheme are not necessary to gain the mark.

◆ The order of points does not have to be as written (unless stated otherwise).

◆ If the candidate's answer has the same "meaning" or can be clearly interpreted as being the same as that in the mark scheme then award the mark.

◆ Mark positively. Give candidates credit for what they have achieved, and for what they have got correct, rather than penalising them for what they have not achieved or what they have got wrong.

◆ Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.

◆ Occasionally, a part of a question may require a calculation whose answer is required for subsequent parts. If an error is made in the first part then it should be penalised. However, if the incorrect answer is used correctly in subsequent parts then **follow through** marks should be awarded. Indicate this with **"ECF"**, error carried forward.

◆ Units should always be given where appropriate. Omission of units should only be penalised once. Indicate this by **"U-1"** at the first point it occurs. Ignore this, if marks for units are already specified in the markscheme.

◆ Do not penalise candidates for errors in significant figures, unless it is specifically referred to in the markscheme.

Option A – Analysing Ecosystems

A1. (a) *Allow any reasonable method.*

description of method for non-motile organism (plants, mussels):
measure area;
use of quadrats;
count organisms within area;
calculate number per unit area;

evaluation:
problems such as organisms part-in / part-out of quadrat;
difficulties of very large organisms (*e.g.* trees);
problem of organisms where it is impossible to clearly distinguish individuals
(*e.g.* some plants);

for motile organisms:
measure out area / use naturally limited area such as small pond;
use Lincoln index;
trap organisms and mark;
release and allow to mix with population;
retrap, counting number of marked individuals;
use formula to calculate number

$$\text{population} = \frac{\text{no. marked at } t_1 \times \text{no. captured at } t_2}{\text{no. marked organisms caught at } t_2};$$

use aerial photos for large organisms (trees; possibly waterfowl);

evaluation:
e.g. for Lincoln index method: problem of births and deaths between trappings;
inward or outward migration;
some organisms become habituated to trapping / "trapshy"; *[5 max]*

Generally [3] for description and [2] for evaluation unless account of method is very detailed; in which case up to [4] may be awarded for method and [1] for evaluation. No mark for organism's name; it is intended simply to focus attention. However, responses must apply to organism selected – if not mark out of [3].

(b) some indices of diversity / *e.g.* Simpson's index;
take account of both the abundance of species in an ecosystem and the number of different species present; *[2]*

(c) carefully observe / measure specimen (colour, length, number of limbs) *etc.*;
use key / by working through logically comparing characteristics of specimen with those in key;
compare specimen with illustrations in field guide / reference collection or herbarium;
characteristics such as sound (birds, insects) / distribution / time of year;
good practice recommends that as far as possible identification should be done in the field and removing / killing / picking specimens should be avoided;
any other reasonable answers; *[2 max]*

(d) (i)   name of ecosystem and brief description   *[1]*

Must be reasonably specific: "lake" is insufficient; "Lake Neerabup, north of Perth, Western Australia" gets the mark.

(ii)   description of human activity;
must be appropriate to example: for above, "cultivation of peat surrounding lake for vegetable-growing";   *[1 max]*

(iii)   abiotic factors: *e.g.* temperature / turbidity / pH / salinity   *[1]*
Must be appropriate.

(iv)   must establish clear link between activity and factor;
and indicate direction or nature of change (*e.g.* increase or decrease);   *[2]*

(v)   for above lake example: test pH by noting colour change using pH-testing kit;
perform a number of tests and take mean;
ideally test before and after change and note difference;
and at different sites;   *[2 max]*
Method must be appropriate to example.
*Any reasonable example allowable. No marks if response gives a **biotic** factor.*

(e) (i)   the change in some factor or factors (biotic or abiotic) over a distance / *OWTTE*;
such as the change in the amount of time organisms are exposed to air across the distance from high tide mark to the extremes of low tides on a seashore;
any other reasonable example;   *[2 max]*

(ii)   mark out transect across gradient using tape or similar;
establish quadrats at appropriate distances apart along transect;

apply (Simpson's) diversity index to each quadrat;

$$D = \frac{N(N-1)}{\sum n(n-1)};$$

where D = diversity index, N = total number of organisms of all species n = number of individuals of a particular species;   *[2 max]*

*Allow **[1]** if diversity index is well explained, even if the concept of environmental gradient is misunderstood*

Responses need not have formula completely accurate for full marks, providing method is clearly understood.

Option B – Impacts of Resource Exploitation

B1. (a) (i) the area of land (and water) required to support a defined human population at a given standard of living;
the measure takes account of the area required to provide all the resources needed by the population, and the assimilation of all wastes / *OWTTE*;   *[2 max]*

This is the definition in the glossary of the syllabus booklet. If partly correct but incomplete allow [1].

(ii) China has largest area and largest population;
but footprint in ha per head of population is very low (due to low standard of living);
so footprint of whole population is less than area of country;

Australia has very large area in relation to population;
but footprint per head is higher than that of China due to higher standard of living;
but still only a fraction of area of country;

Singapore has a much smaller population than either China or Australia but in a very much smaller area / has very high population density;
footprint per head is lower than that of Australia, and higher than China;
but because of tiny area, total is many times larger than that of whole "city-state" of Singapore;
which is highly urbanised, growing little of its own food *etc.*;   *[5 max]*

Clearly responses do not need all the above points for full marks. Look for strong comparison and understanding of relationships for the full [5].

(b) *Any reasonable points acceptable; must have **one** advantage and **one** disadvantage for each mark.*

oil-fired:
advantages
may be fairly cheap, especially if oil available locally;
well-understood technology;
disadvantages
produces carbon dioxide which may contribute to greenhouse effect;
serious difficulties if oil supply interrupted / supplies of oil finite;
some crude oils contain sulfur, so burning may contribute to acid rain;
smoke → chronic respiratory problems;

nuclear:
advantages
once constructed fairly cheap to run;
no addition of greenhouse gases to atmosphere;
can run for long periods on small mass of fuel;

disadvantages
high initial building costs;
great problems of disposal of nuclear waste;
risk of accidents, crime, terrorism;
risk of leaking of radioactive materials into environment;
very high costs of decommissioning;   *[2 max]*

(c)   *One strategy with advantage for each mark. Nothing for disadvantages.*

solar power:
production of energy causes little pollution / cheap to run once equipment in place / suitable for remote area, where cabling would be expensive;

hydroelectric power:
production of energy causes little pollution / cheap to run once power station built / can sometimes be integrated with irrigation;

improved insulation in homes and factories:
allows same amount of energy to "go further" ;

or energy from refuse / biogas / geothermal power / wind power / tidal power;
or any reasonable alternative;   *[2 max]*

(d)   (i)   example of named system: wheat-production in Australian wheat belt;
          No mark for name but, mark out of [3] if none specified.

          inputs:
          large area of land;
          seeds;
          fertilizers, especially superphosphate;
          water (mainly from relatively low rainfall);
          energy in the form of petrol (gasoline), electricity, diesel fuel = energy subsidy;

          outputs:
          wheat sold off farm (contains energy and N, P, K);
          heat;
          CO_2;
          O_2;   *[4 max]*

     (ii) *impacts*:
          reduction of biodiversity;
          e.g. from ecological complexity of Australian bushland community to monoculture;

          leaching of fertilizers into water bodies;
          causing eutrophication;

          soil erosion;
          e.g. removal of topsoil by wind in absence of vegetation cover;

          increase in soil salinity;
          leaching of salt in soil (towards valley bottoms) as the result of reduced transpiration following removal of natural vegetation;   *[2 max]*

          Responses will depend on example selected for (d) (i). For the full [2] there needs to be more than a one or two word response; there should be some explanation or exemplification.

(e)   *changes*:
     e.g. increased use of monocultures / increased use of selective breeding to produce high-yield crops / use of genetically modified foods / biological control / reduced consumption of meat in some societies / increased amount of processing and thus possibly energy use / decrease in diversity *(but do not allow this if already given in (d))*;

     Allow any reasonable suggestions.

     To receive each mark the response must give both the change and the reason for that change e.g.

     increased use of pesticides – reliance on chemical methods to increase production for growing populations;
     OR
     decreased use of pesticides – perception of environmental difficulties and reliance on alternative strategies such as biological control;   *[3 max]*

Option C – Conservation and Biodiversity

C1.   (a)   *describe*:
very low numbers of extinctions before 1650;
slightly higher number 1651 to 1850 / approximately 0.5 species per year;
rapid increase 1851 to 1950 / approximately 2.5 per year;
decrease in extinction rate since 1951 to approximately one species per annum;   *[2 max]*

explain:
extinction rate before 1850 low as human effect on biodiversity low as population pressure on environment relatively low;
extinctions before 1850 not fully recorded;
extinction rate 1851 to 1950 much higher due to rapid human population increase;
and rapid rate of habitat loss;
decrease in extinction rate since 1951 due to greater efforts to protect endangered species and ecosystems;
or many vulnerable species already extinct;
any other reasonable points;   *[3 max] [5 max]*

(b)   low total numbers / long or complex migration route / specialised habitat / specialised food sources / widely hunted or otherwise used by humans / low reproduction rate / large number of predators / susceptibility to disease / limited distribution / catastrophe such as flooding or meteor impact;
any other reasonable points;   *[2 max]*
Responses need two factors per mark.
Factors must be specific to extinction of organisms. No credit for vague answers such as "global warming" or "degradation of environment".

(c)   *endangered*:
species in danger of becoming extinct in the immediate future because their numbers have declined to a critical level;

extinct:
species believed to no longer exist alive;   *[2 max]*

(d)   *Any reasonable example: reasons must be appropriate to example.*
[1] for name and [2] for reasons e.g.
name: Dodo;
reasons: confined to small island (Mauritus);
extreme tameness;
hunting as a source of food by visiting sailors;
destruction of forest habitats;
competition with introduced organisms, *e.g.* pigs;   *[3 max]*

> **Note**: *recent research has suggested that dodos were not **very** tame and that the flesh was unpleasant to taste; thus habitat destruction and introduction of pigs (and rats) were probably most significant factors. However, the points given above are widely mentioned in the literature and may be considered acceptable responses.*

(e)   (i)   *[1] for name, [1] for brief description e.g.*
            Kakadu National Park, Northern Territory, Australia;
            tropical savanna with extensive wetlands;   *[2 max]*

      (ii) *Any reasonable examples, but must have some evaluation for full [5] marks.*

            For above example:
            measures:
            designation as World Heritage Area by UNESCO;
            involvement of Aboriginal people in management;
            concentration of visitor pressure, campsites, into limited areas;
            strict protection of flora and fauna by law;
            international agreements with Japan, China to protect migratory birds;
            attempts to eliminate introduced species;   *[3 max]*

            evaluation:
            considerable success, as measured by visitor numbers;
            and protection of habitats and biodiversity;
            success due to use of modern scientific techniques and traditional land management;
            and due to use of local, national and international measures;   *[2 max] [5 max]*

(f)   genetic diversity represents the variety of genetic material in a gene pool or population,
      habitat diversity is the range of different habitats or ecological niches in an
      ecosystem, community or biome / *OWTTE*   *[1 max]*

Option D – Pollution Management

D1. (a) *Both must be correct for [1].*

(i) 1970

(ii) 1970 *[1 max]*

(b) *Must have "improved" and a satisfactory reason for [1].*

improved. Lead is toxic and concentrations have declined substantially / water was very acidic and is, by 2000, approaching neutrality / acid water often has lower biodiversity; *[1 max]*

(c) *A mark for each of **three** valid points: don't expect too much. No mark for simply saying there has been an improvement – already rewarded;*

water may have been very polluted;
as the result of chemical or metallurgical industries / run-off from roads;
but there may have been improvement over 30 years through legal controls, regulations;
extraction of pollutants before water released into lakes;
high acidity might have been counteracted by adding alkali;
as water becomes less acidic it leaches less lead out of environment;
cessation of use of leaded petrol;
any other reasonable alternative; *[3 max]*

(d) measurement of species diversity;
by collection under standard conditions for a set time;
and comparing results at different sites / times;
use of indicator organisms;
any other reasonable alternative; *[2 max]*

(e) (i) the natural or artificial enrichment of a body of water, particularly with respect to nitrates and phosphates / *OWTTE*; *[1 max]*

(ii) rapid growth of algae;
high rate of decomposition;
low levels of oxygen;
death of aerobic organisms;
increased turbidity;
loss of macrophytes;
loss of species diversity;
reduction in length of food chains;
aesthetic deterioration (smell, *etc.*); *[3 max]*
Do not allow a point already rewarded in (i).

(f)   *Responses may approach the question by mentioning "early" or "upstream" strategies or "later" or "downstream" ones. Reward understanding of principles and practical details.*

altering activity producing pollution;
by switching to slow-release fertilizers;
other methods of encouraging crop growth;
alternative (non-P) detergents;
regulation and reduction at point of emission
e.g. by sewage treatments that remove N and P;
"post-pollution clean-up";
by pumping mud;
chemical treatment;
replanting vegetation indigenous to area;
reintroducing fish / other organisms;   *[5 max]*
any other reasonable suggestions;

(g)   (i)   *advantages*:
            substantial reduction of waste volume;
            unsophisticated technology;
            energy released may be used as source of power;
            destroys pathogens;
            in some circumstances may be cost-effective;   *[2 max]*

       (ii) *disadvantages*:
            disposal of ash;
            atmospheric pollution;
             CO_2 produced;
            loss of material such as paper, cardboard, plastics that might be recycled;
            smoke;
            aesthetic, smell *etc.*;
            loss of organic material that might be composted;
            any other reasonable suggestion;   *[2 max]*